Space Weather Technical Forecast

Issued on Monday, 17 January 2022 at 12:19 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of isolated M-class flares (R1/R2 radio blackouts) throughout. Active fluence may develop from later Day 1 (17th).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low with a single long duration C2 flare over the past 24 hours. This was a C2.4 observed at 16/1945 UTC and originating from AR2929. There are currently seven sunspot regions on the visible disc. AR2929 and AR2930, both located in the northwest quadrant, are the two regions most likely to produce a significant flare due to their size and complexity. AR2930 continues to grow in overall size with intermediate spots having emerged. AR2931 continues to fade as it transits towards the west limb. AR2932 in the northeast, remains small and simple. AR2933, approaching centre disc in the southern hemisphere, has shown a trend to split and widen. AR2925 and AR2927 in the southwest quadrant remain small, simple, single sunspots.

A CME from the 14th January may still give a weak glancing blow at Earth on the 17th, although this risk is diminishing. The long duration C2 flare originating from AR2929 produced a CME directed mainly to the northwest. This has been initially analysed as missing Earth, but further analysis is pending to confirm this. There are no other Earth-directed CMEs visible in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds as observed by DSCOVR at L1 are indicative of ongoing high speed stream influence from CH44/-. Wind speeds have been mostly around 550 km/s, with occasional peaks around 625km/s late UTC on 16th. Density was occasionally above average. Total IMF strength, Bt, was weak mainly 3-8nT. The Bz component also fluctuated weakly, ranging between +6/-5 nT. Phi angle was predominantly negative (towards the Sun). Geomagnetic activity was Quiet to Active through to 16/0300UTC, becoming Quiet thereafter.

Energetic
Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at Background levels throughout. High energy electron flux (greater than 2MeV) was at moderate to high levels, with a peak value of 2280 pfu at 16/1910 UTC. Electron fluence is starting the period just below Active levels (1e8 integrated pfu), but is likely to reach or exceed Active later on Day 1 (17 Jan). Active levels may then be maintained into Days 2 and 3 (18th and 19th). A Fluence value of 4.82e7 integrated pfu was recorded at 17/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be mainly Low with further C-class flares expected, and a chance of isolated M-class flares. Another two active regions are expected to rotate on from the far side within the next 24-48 hours, and this may increase solar activity.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are currently expected, although one CME may still pass close to Earth on Day 1 (17 Jan), however this risk is diminishing. The

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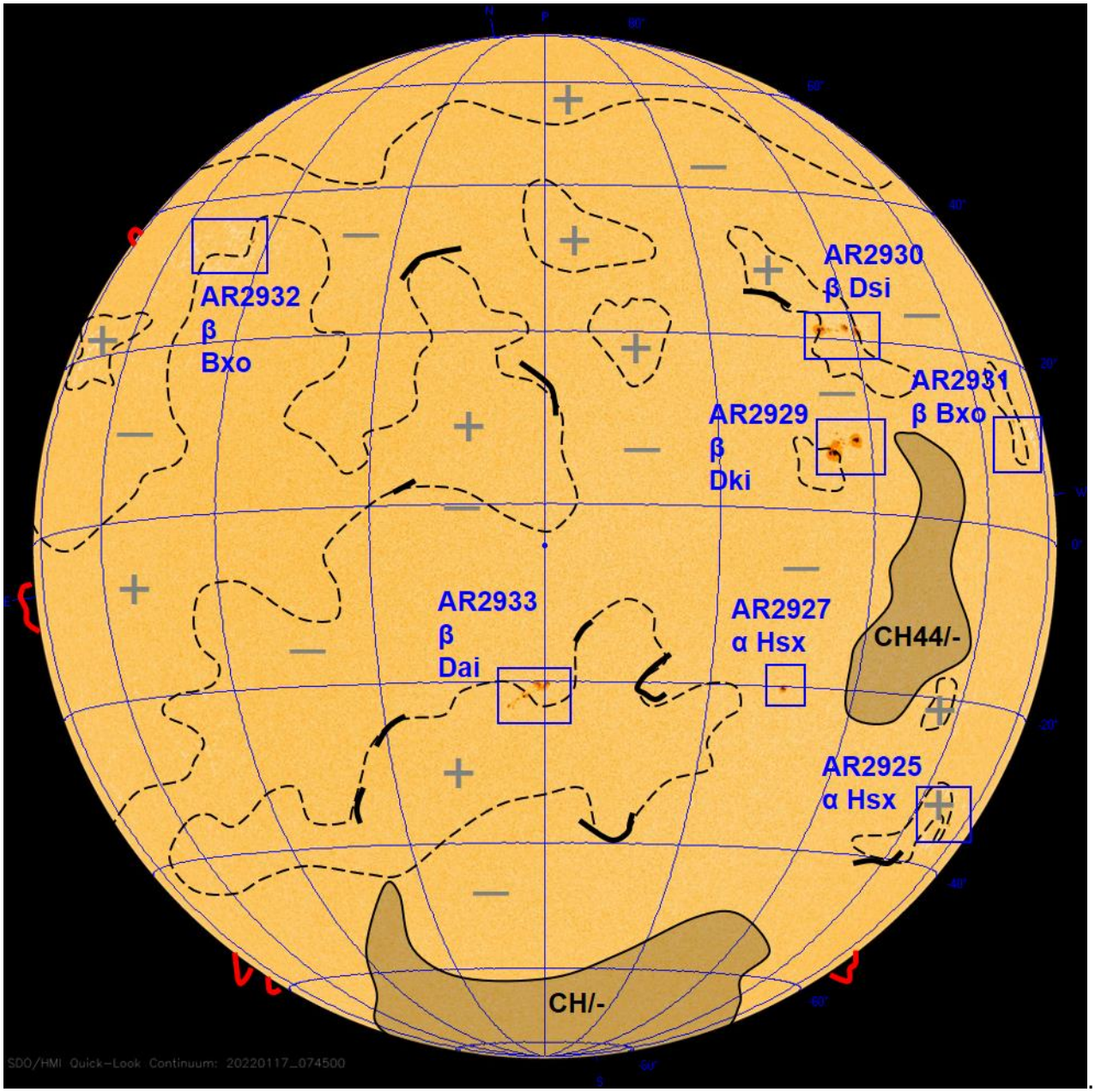
solar wind is expected to remain elevated to slightly elevated on Days 1 & 2 (17-18 Jan), with a gradual return to background levels from Day 3 (19 Jan) as the effects of CH44 begin to wane. Unsettled to Active periods are likely at times on Day 1 (17 Jan), with a slight chance of an isolated G1/Minor Storm still possible at first, due to a diminishing risk of a glancing blow from a weak CME. Geomagnetic activity is then expected to decline to Quiet to Unsettled levels from Day 2 (18 Jan) onwards.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is forecast to remain at predominantly background levels. The high energy electron flux (greater than 2MeV) may continue to rise over the next 24 hours or so, following connection with CH44. Electron fluence may increase further to reach Active levels from later on Day 1 (17th).

Figure 1. Solar Analysis Valid 17/0800 UTC.



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Met Office Space Weather Technical Forecast

Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

A CME associated with a filament lift-off on the afternoon UTC of the 14th, in the southwest quadrant near AR2925, may give, albeit with a low and diminishing risk, a glancing blow at Earth on Day 1 (17 Jan). This was a southward directed CME so the bulk of the ejecta is expected to pass below Earth. Confidence is low regarding this CME, and may not be a feature of the forecast due to its diminishing risk at present, with no evidence in the current DSCOVR solar parameters. Also, the C2 flare originating from AR2929 produced a CME directed mainly to the northwest. This has been initially analysed as missing Earth, but further analysis is pending to confirm this. There are no other Earth-directed CMEs visible in available imagery.

The solar wind speed is expected to continue at elevated levels through Day 1 (17 Jan) and possibly into Day 2 (18 Jan), with speeds between 500-600 km/s. The HSS influence is then expected to gradually decline back to ambient levels from Day 3 (19 Jan).
Geomagnetic activity is expected to be Unsettled to Active at times on Day 1 (17 Jan) with a slight and diminishing chance of an isolated G1/Minor Storm due to a possible weak glancing blow from the aforementioned weak CME. Geomagnetic activity is expected to decline to Quiet to Unsettled levels from Day 2 (18 Jan).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

None currently expected.

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Radio Blackouts - X-Ray Flares:

Solar activity has been Low with a single long duration C2 flare over the past 24 hours. This was a C2.4 observed at 16/1945 UTC and originating from AR2929. There are currently seven sunspot regions on the visible disc. AR2929 and AR2930, both located in the northwest quadrant, are the two regions most likely to produce a significant flare due to their size and complexity. AR2930 continues to grow in overall size with intermediate spots having emerged. AR2931 continues to fade as it transits towards the west limb. AR2932 in the northeast, remains small and simple. AR2933, approaching centre disc in the southern hemisphere, has shown a trend to split and widen. AR2925 and AR2927 in the southwest quadrant remain small, simple, single sunspots.

Two further far-side sunspot regions (ex-2916 and 2918) are also likely to rotate onto the disc in the next 24-48 hours. This brings a slightly increased chance of M-class flares, and probabilities have been increased during the period to reflect this.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	40	40	40
Very Active	R3 to R5 X Class	No	2	5	5	5

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 has returned to background levels. Background levels are forecast to continue barring any significant flares or new Earth directed CMEs in the period.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	2	2	2	2
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons Event (≥ 2MeV):

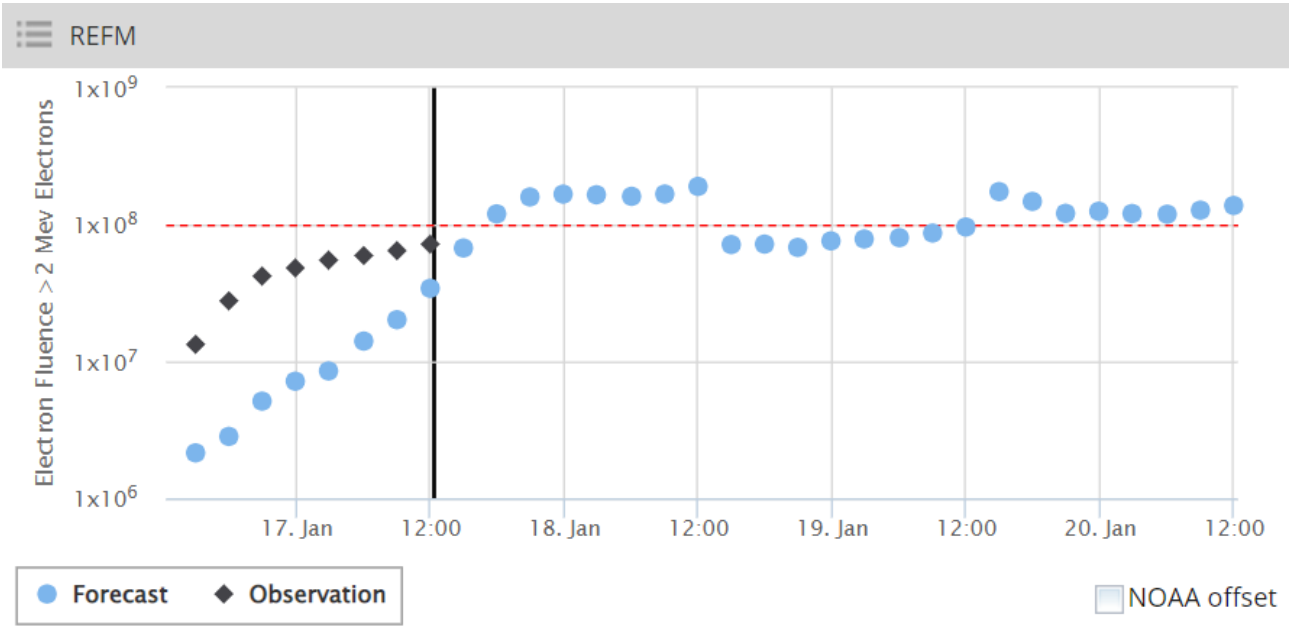
High energy electron flux (greater than 2MeV) was at moderate to high levels, with a peak value of 2280 pfu at 16/1910 UTC. Similar levels, and with a rising trend over the next 24 hours or so, are likely to continue for much of the period. However, there is still the low and diminishing possibility of a glancing blow from a weak CME during Day 1 (17 Jan), which could give a temporary suppression in electron levels, although this is low confidence.

The associated 24-hour electron fluence is starting the period just below Active levels, but is likely to reach or exceed Active later on Day 1 (17 Jan). Active levels may then be maintained into Days 2 and 3 (18th and 19th).

The Met Office REFM output is currently giving reasonable guidance, showing an increasing trend in the fluence levels, with the likelihood of reaching the Active from the second half of Day 1 (17 Jan) and possibly maintaining Active levels for much of the rest of the period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	60	80	70	50
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	5	5	1

Figure 2: MOSWOC REFM.



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